

tion of camphor was 6,877,297 lbs. and 6,935,285 lbs. respectively. In the fiscal year 1917 (the last return I have seen) the production of camphor is given as 7,371,574 lbs. and camphor oil as 6,727,512 lbs. These figures show that the industry has remained about stationary but the tendency now is toward a decline which must increase until plantation camphor becomes available. The quantity of camphor sold in the fiscal year 1917 is given as 9,308,960 lbs. valued at \$3,466,150 gold; of camphor oil as 2,531,819 lbs. valued at \$244,961 gold.

THE AMERICAN AND ASIATIC SPECIES OF SASSAFRAS

ALFRED REHDER

THE genus *Sassafras* stood for a long time as an example of a very distinct monotypic genus peculiar to the flora of eastern North America, until comparatively recently, in 1907, a Chinese species, *Sassafras tzumu*, was added to it by Hemsley. This Chinese species, though it is so similar in its general appearance, in its inflorescence and fruit that without close examination it is difficult to distinguish from the American *S. officinale*, differs in its floral structure in several important particulars, and for this reason was made by H. Lecomte the type of a distinct genus under the name *Pseudosassafras*. The chief differences are the hermaphrodite or apparently hermaphrodite flowers, the presence of a fourth staminal whorl consisting of three staminodes and the pubescence on the inside of the base of the perianth. Now a third closely related species appeared when Mr. Wilson, while arranging his extensive collection of the plants he brought back from Formosa, drew my attention to a plant described by Hayata as *Lindera randaiensis*, which looked almost exactly like the Chinese *Sassafras tzumu*. On closer examination this similarity extended even to the more minute structure of the flower except that the anthers had only 2 locules as correctly described by Hayata for his *Lindera randaiensis*, instead of 4, as a true *Sassafras* should have. The number of locules has been considered by most botanists who have dealt with Lauraceae a very important character, particularly by Pax who bases the main division of the whole family on this character; Bentham & Hooker, Lecomte and others lay much stress on this character, which, however, seems to lead to an artificial classification. Species with 2-loculed anthers may occur in genera with normally 4-loculed anthers, as in *Persea cuneata* Meissner; and in *Persea* § *Heterandra* the anthers of the third series of stamens have two locules, instead of the normal four of the first two series; the same is the case in *Phoebe* § *Heteranthera*. Also the reduction of hermaphrodite flowers to dioecious flowers does not necessitate generic separation, as we have both kinds of flowers in genera like *Ocotea*, *Aydendron*, *Cinnamomum* and others, nor does the absence or abortion of a staminodial whorl necessitate generic separation, as the presence or absence of staminodes varies in many genera. Instead of using the structure of the anthers whether introrse or extrorse, 4-celled or 2-celled, as the chief

character for the principal groups of the family, we seem to arrive at a more natural arrangement if we consider with Mez (Laurac. Amer. Monog. in Jahrb. Bot. Gart. Mus. Berlin, v. [1889]) the nature of the inflorescence as one of the most important characters. According to his arrangement *Sassafras* belongs to the tribe Litseae which is nearly the same as Litsaeaceae of Bentham & Hooker except that Mez refers *Sassafridium* which has a paniculate inflorescence to *Ocotea* of the tribe Perseae. From all the genera of the tribe Litseae the genus *Sassafras* is easily separated by its racemes of slender-pedicelled flowers, in the axils of the basal scales of the terminal branch-bud, while in the other genera the flowers are arranged in lateral umbels or heads sometimes reduced to one flower, subtended by an involucre of 4-6 bracts, or as in *Actinodaphne* in lateral subsessile fascicles. The genus most closely related to *Sassafras* is apparently *Benzoin* to which the Formosan *Sassafras* with 2-loculed anthers forms a transition. Very close to *Benzoin* is *Litsea* which differs from it in no other character than in the 4-loculed anthers and should be united with it, if the number of locules is not considered a sufficient generic character. These three genera are the only Lauraceae with all (in *Sassafras*) or part of the species deciduous.

All three species of *Sassafras* agree perfectly in their vegetative characters, in habit, in bark, in their winter-buds, in the deciduous leaves with a more or less pronounced tendency toward lobing, in the inflorescence and in the fruit, and the differences in the structure of the flowers are only such as can be explained by suppression or abortion. The phylogenetic type of the genus is apparently *S. tzumu* which has a typical Lauraceous flower; from this type the Formosan species deviated by the suppression of the two upper smaller locules of the anther, and *S. officinale* by the abortion of the staminodes and by a more advanced state of dioecism already indicated in *S. tzumu*. As the admission of the two Asiatic species to the genus necessitate some change in its characters a revised generic description may be given here.

Sassafras Nees & Ebermaier, Handb. Med.-Pharm. Bot. II. 411 (1831).—*Pseudosassafras* Lecomte, Notul. Syst. II. 268 (1912).

Flores dioeci vel androdioeci floribus masculis ovario fere normali instructis, laxe et breviter racemosi, racemis pedunculatis, involucre proprio fere omnino destitutis, e gemmis terminalibus simul cum innovatione orientibus; perianthii tubus fere subnullus; segmenta 6, subaequalia, debilia, lanceolata; stamina 9, ordinis tertii basi utrinque glandula stipitata aucta; staminodia 3 vel in specie dioeca nulla; speciei dioecae flores masculi ovario omnino destituti et feminei tantum staminodiis 6 instructi; filamenta angusta; antherae introrsae, 4- vel 2-locellatae: ovarium ovoideum, stylo longiusculo: bacca perianthii tubo aucto carnosio breviter cupulato margine truncato vel sinuato insidens. — Arbores cortice crasso suberoso profunde fissio cinnamomeo: gemmae ovoideae squamis pluribus imbricatis rotundatis vel late ovatis: folia alterna, decidua, penninervia vel 3-lobata et 3-nervia: flores praecoces, flavescens: racemi fructiferi ad basin ramulorum; bacca subglobosa vel breviter ellipsoidea, nigro-coerulea, basi

cupula aurantiaco vel rubro circumdata; pedicelli supra medium incrassati.

Flores dioeci, intus glabri, masculi staminodiis et ovario destituti, feminei staminodiis 6 instructi; antherae 4-locellatae: folia saepe trilobata . . . 1. *S. officinale*.

Flores androdioeci, intus basi pilosi, masculi ovario fere normali, omnes staminibus 9 et staminodiis 3 instructi.

Antherae 4-locellatae: folia saepe trilobata 2. *S. tzumu*.

Antherae 2-locellatae: folia rarissime trilobata 3. *S. randaiense*.

1. *Sassafras officinale* Nees & Ebermaier. — For synonyms and literature see Sargent, *Sylva N. Am.* vii. 17 (1895). For nomenclatorial discussion see Blake in *Rhodora*, xx. 98 (1918).

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2. *Sassafras tzumu* Hemsley in *Kew Bull. Misc. Inform.* 1907, 55; in *Hooker's Icon.* xxix. t. 2833 (1907). — Henry in *Elwes & Henry, Trees Gr. Brit. Irel.* iii. 515 (1908). — Rehder in *Bailey, Stand. Cycl. Hort.* vi. 3082 (1917). — *Pseudosassafras Tzumu* Lecomte, *Notul. Syst.* ii. 269 (1912); *Nouv. Arch. Mus. Paris, sér. 5, v.* 108 (1913).

CHINA. Western Hupeh and Kiangsi (see Sargent, *Pl. Wilson.* ii. 74, for enumeration of specimens). Chekiang: Ningpo, 1908, *D. Macgregor*; Shi-bunshan, June 26, 1915, *F. N. Meyer* (No. 1456); Mōkan-shan, August 5, 1915, *F. N. Meyer* (No. 1617). Hunan: "ad minas Hsikwangshan prope urbem Hsinhwa," alt. 500–800 m., May 14, 1918, *H. Handel-Mazzetti*. Kweichou: "in jugo inter vic. Lopusse et Wendnen, prope opp. Duyün," alt. 900 m., July 11, 1917, *H. Handel-Mazzetti*. Eastern Szechuan: without locality, *P. Farges* ex Lecomte.

In addition to the characters mentioned above *S. tzumu* differs from *S. officinale* in the stouter and darker colored branchlets, the larger winter-buds, the larger leaves glaucous beneath, the lobes more acuminate, in the smaller flowers with shorter sepals and stamens and in the somewhat smaller nearly globose fruit. The staminate flowers can be distinguished from the fertile hermaphrodite flowers only by the slightly smaller and often somewhat deformed ovary which, however, may be sometimes fertile, as the staminate trees, according to Mr. Wilson's observation in China, usually produce occasional fruits. The tree, though apparently hermaphrodite, is functionally dioecious, a behavior which I have called elsewhere (*Rhodora*, vi. 18) pseudomonoclinism.

3. *Sassafras randaiense*, comb. nov. — *Lindera randaiensis* Hayata in *Jour. Coll. Sci. Tokyo*, xxx. art. 1, 257 (*Mat. Fl. Formosa*) (1911); *Icon. Pl. Formos.* v. 179, fig. 62b (1915). — Kanehira, *Trees Formosa*, 438 (1917).

FORMOSA. Arisan, prov. Kagi, alt. 2300–2500 m., October 30, 1918, *E. H. Wilson* (No. 10800; tree to 26 m. tall, 3 m. girth); east of Arisan, alt. 2200 m., October 30, 1918, *E. H. Wilson* (No. 10800a).

This species is very similar to *S. tzumu*, but differs in its 2-loculed anthers, a character which I have found constant in a considerable number of flowers examined. Other slighter differences will be found in the slightly more elongated and pointed winter-buds and in the longer and comparatively narrower leaves of firmer texture. Judging by the copious material col-

lected by Mr. Wilson from several large trees, among which I find only a single leaf with one lateral lobe, the leaves of older trees are almost invariably entire, but they are partly three-lobed on his specimens of young plants. The only fruit collected is smaller than that of the Chinese species and measures 6 mm. in diameter.

The Formosan species occurs only in scattered individuals on the mountains Arisan and Randaisan and possibly elsewhere on the island, while each of the other two species has a much wider distribution and is much more common within its range. All the species, however, are only relics as compared with the range of the genus during the Tertiary period, when it was distributed apparently all over the northern hemisphere.

NOTES ON NORTH AMERICAN TREES. VI¹

C. S. SARGENT

Hamamelis

THE different species of *Hamamelis* cannot be distinguished by good morphological characters, the structure of the flowers, fruits and seeds being the same in them all, and in view of the superficial botanical surveys on which the earlier publications on the plants of the southern states were based it is not surprising that all the Witch Hazels in North America have usually been referred to a single species, *Hamamelis virginiana* L. Walter, however, in 1788 mentioned without descriptions three species, *dioica*, *monoica* and *androgyna*, and in 1814 Pursh described his *H. macrophylla* based on a specimen collected by Lyon on river banks in the western part of Georgia and chiefly distinguished by the tubercles on the lower surface of the leaves. After Nuttall in 1818 and Elliott in 1821 no American author has considered Pursh's plant which has been referred without comment to *H. virginiana*. In 1911 I described as *H. vernalis* a small winter-flowering shrub spreading into thickets by stolons and common on the gravelly banks of streams in southern Missouri and now known to extend through Arkansas into eastern Oklahoma and distinguished from *H. virginiana* by the red color of the inner surface of the calyx-lobes and by the shape of the leaves which are often round at apex, more symmetrical at base, less coarsely lobulate and pale and often glaucous below. At one time I believed that the Witch Hazel of Louisiana could be referred to this species, but the leaves of all the specimens of *Hamamelis* which I have seen from the Gulf States are covered with tubercles. These are the enlarged bases of the short stellate hairs which cover the young leaves and are more prominent on the lower than on the upper surface. Such tubercles are not common in *Hamamelis*, and have not been found on the leaves of any other species except occasionally on one of the Japanese species. These tubercles, the smaller flowers which open from December to February with a calyx only 5 mm. across the flattened lobes and pale yellow sometimes streaked with red, petals only 8 mm.

¹ For part. V, see p. 61.